DOCUMENT RESUME

ED 344 763 SE 052 728

TITLE Science: Grade 4. Interim Guide.
INSTITUTION Manitoba Dept. of Education and Training, Winnipeg.
REPORT NO ISBN-0-7711-1009-X
PUB DATE 91
NOTE 135p.; For other individual guides, Kindergarten through Grade 9, see SE 052 724-733.
PUB TYPE Guides - Non-Classroom Use (055) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC06 Plus Postage.
DESCRIPTORS Acoustics; Classroom Environment; Curriculum Guides; Earth Science; Ecology; Electricity; *Elementary School Science; Foreign Countries; *Grade 4; Intermediate Grades; *Process Education; Science Activities; Science Instruction; *Scientific Concepts; Student Attitudes
IDENTIFIERS Cells (Biology); Concept Maps; Manitoba; *Scope and Sequence

ABSTRACT

This guide is one of a set of 10 science guides, each covering a separate grade in Manitoba, together covering kindergarten through grade 9. The guides have been designed to provide a framework for building scientific concepts and developing the learning of process skills. They replace an earlier set of guides dated 1979. Each guide is essentially the same through the first 16 pages, after which the core units vary appropriately for each academic level. Three themes and units within those themes which are carried through the K-4 program include: (1) environmental interdependency and interaction--population interaction (grade 4); (2) matter and energy--electricity/structures/ sound (grade 4); and (3) earth, time and space--water and land (grade 4). (AA)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED344763

Manitoba
Education
and Training

1991

science: grade 4

interim guide

SE 052 728

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

K.A. Cosens

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

BEST COPY AVAILABLE

science: grade 4

interim guide

THIS GUIDE IS SUBJECT TO REVISION ON THE BASIS OF INFORMATION RECEIVED FROM SCHOOLS. IT IS EXPECTED THAT MODIFICATIONS WILL NOT BE MADE IN THE DESIGN OF THE PROGRAM. RATHER, CHANGES MAY BE MADE IN AREAS CONCERNING STRATEGIES AND IMPLEMENTATION.

manitoba education and training

1991

ISBN 0-7711-1009-X

This guide has been prepared by Manitoba Education and Training to meet the needs of grade 4 students. This guide has been revised on the basis of feedback from teachers during the period of 1988-89. It has been designed to articulate with the new K-3 and 5-9 Science guides and to provide a framework for building scientific concepts and developing the learning of process skills. This guide may be used in September, 1991, in place of the previous (1979) guide.

The Department of Education and Training wishes to acknowledge the contributions of the following members who constituted the committees responsible for the development of this guide.

ACKNOWLEDGEMENTS

H. Grunau (Co-Chairperson), Faculty of Education, University of Manitoba

D. Shipman (Co-Chairperson), Gladstone Elementary School, Pine Creek School Division No. 30

V. Bechrakis, Harold Hatcher School, Transcona-Springfield School Division No. 12

D. Clark (Writer), Wellington School, Winnipeg School Division No. 1

N. Kolafa, Assiniboine School, St. James-Assiniboia School Division No. 2

S. Johnston, Beaumont School, Assiniboine South School Division No. 3

W. Soprovich, Consultant, Curriculum Development and Implementation Branch, Manitoba Education and Training (until December 1988).

E. Cicierski, Consultant, Curriculum Services Branch, Manitoba Education and Training

E. Uzwyshyn, Consultant, Curriculum Services Branch, Manitoba Education and Training

Appreciation is extended to the following teachers who participated in piloting the program:

Grade 4

H. Bailey, Rolling River School Division #39
J. Driedger, Midland School Division #25
E. Holenski, Winnipeg School Division #1
J. Linklater, Swan Valley School Division #35
I. Rainka, Beautiful Plain School Division #31

CONTENTS

	Pages
OBJECTIVES OF THE CURRICULUM	1
. Aims	1
. Role of Science in General Education	1
THE LEARNER	2
. Variety and Nature of Children	2
. Misconceptions in Science	2
. Girls in Science	3
THE TEACHING ENVIRONMENT	4
. Program Implementation	4
. Computers in Science	5
. Time Allotment for the Science Program	5
. Enrichment Activities	5
EVALUATION	6
. Student Evaluation	6
. Sample Evaluation Techniques	6
. Safety and Science	8
ATTITUDES AND SKILLS	9
. Attitudes and Values	9
. Science, Technology and Society	9
. Environmental Education	9
. Sustainable Development Strategies	10
. Process Development	10
. Problem Solving	12
SCOPE AND SEQUENCE	14
. Process Development	14
. Attitude Development	15
. General Program Overview K-4	16
. Grades 3 + 5 Concept Maps	17
MATERIALS LIST	27
CORE - GRADE FOUR	
. Electricity	31
. Sound	36
. Structures and Functions	42
. Water and Land	49
. Populations Interactions	56

OBJECTIVES OF THE CURRICULUM

AIMS

"Science is a search for understanding" through a systematic and cumulative exploration of the natural phenomena of the universe.[1]

Teachers should strive for balance in the science program, and should especially try to make processes development at least as important as content.

The K-4 science program includes the following:

- promoting of attitudes as part of scientific literacy, including:
  - curiosity to explore, ask questions, actively investigate;
  - inventiveness in generating new ideas, using equipment constructively, suggesting new experiments;
  - critical thinking to justify conclusions or predictions and changing ideas in response to evidence or logical reasons;
  - persistence in maintaining an active interest in a problem.
- understanding and use of scientific processes.
- understanding and applying knowledge to practical situations.
- understanding the interactions of science, technology and society by applying them to their environment.

---

[1] H. Grunau, Faculty of Education, University of Manitoba.

Science education provides experiences that are relevant to children on an immediate and personal level, developing attitudes, skills and knowledge for use today and in the future.

Exploration of the above areas, and helping children to apply the ideas in practical situations, provide for use of higher level thinking processes, which in turn provide for self-motivated, independent, concerned participants in society.

ROLE OF SCIENCE IN GENERAL EDUCATION

Children initially examine their environment through concrete experiences within a broad range of interests. One of the important functions science shares with other areas of study is the development of basic processes of classifying, measuring, using space-time relationships, inferring and predicting, and applying these processes to the world around them.

The young child lives in and views an integrated world and this leads to many opportunities for integrating subject areas.

Through interaction with materials in simple group activities, children are able to develop listening, reasoning, and group participation skills. In centre based activities, small groups and individuals develop written communication, graphing and measurement skills, independence and confidence. Children need opportunities to concretely explore and understand relationships in this multi-dimensional world. Science can "spark" interest in all areas of study. An example of the Kindergarten science concept "plants require certain things to grow" is outlined to show one way of integrating objectives from other subject areas i.e., the use of centres.

VARIETY AND NATURE OF CHILDREN

The emphasis of psychologists such as Piaget, Bruner, Ausubel, and Gagne is placed on experience with concrete materials and the child's need to be involved in actively structuring his or her learning. According to Piaget, children pass through an ordered series of developmental stages, believed to be controlled by the maturation of the brain and the nature of a child's experience. These stages aren't limiting, as all children have different experiences in different areas.

Appropriate activities for Piaget's various stages are:

2 to 6 years - Pre-Operational

Being able to manipulate and carry out physically the actions he/she may not be able to carry out mentally. Exploration and experiences of trying things out to see the result enables them to link cause and effect. An activity is repeated several times, if desirable.

7-12 years - Concrete Operational

Exploring a wide range of problems in real situations and gradually coming to see patterns. Planning and carrying out investigations or methods of problem solving which he/she has devised; discussing results and learning from errors about the variables which should be controlled. Putting problems in concrete terms where doing can support thinking.

13-15 years - Formal Operational

Drawing conclusions from previous learning and applying principles to new problems. Testing ideas by planning experiments which control all the necessary variables. Developing abstract ideas about properties of materials; devising and using theoretical models for predicting and explaining.

Taking this into account, the science program must be experience-based and activity-centered. Concrete experiences are essential for the pre-operational and concrete-operational stages in order to meet changing needs, abilities, interests and learning styles of the children. The science program must give children time, space, and encouragement to explore science and consolidate learning inside and outside the classroom.

MISCONCEPTIONS IN SCIENCE

Misconceptions represent complete systems of explanations which are conceptually wrong. They are usually personal and constructed from one's experiences. K-4 children harbour many misconceptions in science, partly due to their limited experiences and stage of mental development. These misconceptions may be adjusted by teaching science through a wide usage of concrete and relevant experiences, and adequate, appropriate discussions of findings in a non-threatening environment. Some examples of misconceptions are:

1. that an object will float in shallow water but will sink in deep water;

2. that because plants need sun, food and water, the plants will flourish if you give them direct 24 hour sunlight, and as much water and fertilizer as possible;

3. that the metamorphosis of mealworms will result in only more mealworns with the misconception expressed by the question: Who put the beetle in the bottle?

Teachers of science who want to modify their children's conceptual framework need to challenge the children's alternative conception. Some guidelines for teachers are:

. ask children for their ideas, respect the ideas and explanation offered;

. guide the students into developing experiments or experiences that will allow them to test their ideas;

. encourage the children to discuss and resolve the discrepancies between their initial predictions and the new evidence;

. always listen to see whether students have adadjusted their conceptual framework after the experiment or experience.

GIRLS IN SCIENCE

Research shows that girls are biased against areas of physical science through home, media and school experiences at as early an age as six years. Girls have already developed opinions about appropriate behaviours and occupations for one or the other sex by this age.

"A girl might aspire to be a lawyer but expect to be a typist in a law office; ....she might aspire to be a doctor but expect to be a nurse."[2]

Teachers must:

. consciously model enthusiasm and involvement in science to motivate children to participate and become involved in science;

. offer bias-free resources (those that give equal consideration to both sexes in career and lifestyle portrayal);

. have equal expectations for boys and girls (studies have shown that boys receive considerably more teacher feedback, occupy more physical space, are more critical of girls and of each other, and generally assume the leadership role in a mixed group);

. encourage both boys and girls in planning, recording, setting up experiments, using equipment and other learning opportunities;

. encourage projects which recognize skills and interests of both sexes and discourage put-downers or devaluing of "female" interests by male students.

[2] "Who Turns the Wheel?", Science Council of Canada, January, 1982, p. 82.

PROGRAM IMPLEMENTATION

The school administrators have an important leadership role in science program implementation. This role includes the following directions or activities:

- encouraging a shared management of implementation for the science program by providing opportunities for cooperative planning.
- monitoring the degree of implementation and the needs of staff.
- determining the implications of the curriculum for staff training and facilities.
- providing easy access to the materials and facilities needed for the program. This will include the provision of sufficient funds which would be used to purchase necessary equipment and materials as the need arises.

Some implications of the science program for implementation into the school include:

- like in the previous curriculum, the new program emphasizes the development of science processes and concepts. The use of activities to develop these processes and concepts will affect teaching methodology and evaluation methods.
- the K-4 science program has introduced new segments within the program: Flotation: A Property of Matter, life cycles, a consolidation of the previous K-1 program, application of science and Implementation may require specific work with teachers in order to increase their knowledge and teaching methodology base for these units.
- the science program suggests some ways to integrate some mathematical and language arts skills into the structure of some topics. Developing additional units whereby mathematics and language skills are an outcome of science units and activities may be required.

Evaluating the effectiveness of the science program consists of judging its worth on the basis of valid information about how well the achieved curriculum meets the objectives of the intended curriculum. Many sources of data should be searched to provide a basis for the evaluation, such as:

- evaluation of student achievement;
- analysis of the methods of evaluation;
- teaching strategies and emphases upon program goals.

Additional sources of information about program evaluation are:

1. Mechling, Kenneth R., "Taking Charge: How Principals can Improve School Science Programs, "Principal, January 1983, pp. 16-21.
2. Mechling, Kenneth R. & Oliver, Donna L., "Activities, Not Textbooks: What Research Says About Science Programs.", Principal, March 1983, pp. 41-43.

3. Mechling, Kenneth R. and Donna L., Promoting Science Among Elementary Principals: Handbook I-IV, National Science Teachers' Association, 1742 Conneticut Avenue, N. W., Washington, D.C., 1983.

COMPUTERS IN SCIENCE

Computers are a recent addition to the learning environment. They offer extensions and support for science learnings. Computers are not a primary means of delivering science education or a replacement for direct investigations. However, they can enrich the science program and provide individual and practice work in a number of ways. These include:

- developing an awareness of the role of complex technologies in society.
- simulations;
- problem solving exercises.

Computers are a way of life in the future for children.

TIME ALLOTMENT FOR THE SCIENCE PROGRAM

Recommended time allotments for K-3 science are 15 minutes daily or 75 minutes weekly and for grades 4-6 are 30 minutes daily or 150 minutes weekly. Time allocations for each unit can vary but teachers should ensure that students are given sufficient time to cover the entire program for any given year.

ENRICHMENT ACTIVITIES

The activities included in the K-4 program provide learning experiences that help students understand and interpret the world in which they live. The activities which appear under the heading of enrichment are intended as extensions to the regular program. These activities have been selected in order to allow students to explore some areas at greater depth.

STUDENT EVALUATION

The general purposes of student evaluation are to provide:

- students with an understanding of their development and needs relative to the program;
- teachers with a basis for planning necessary changes in teaching strategies and the curriculum;
- information for parents and administrators.

Thus, evaluation should be related to program objectives, and in the K-4 science program, it should relate to science processes and attitudes in addition to content. Further, evaluation must be continuous and use a variety of approaches.

Informal observation techniques whereby teachers observe individual and group interactions in an activity can help to determine needed skill development of students and techniques which can be used to improve their skills.

Formal techniques include achievement and performance tests, checklists of processes, attitudes, and manipulative skills and the examination of products such as reports or projects. Although achievement tests (pencil and paper variety) are generally considered to evaluate content most effectively, other objectives of the program such as science processes and attitudes can be evaluated by written and performance items, checklists and other means.

SAMPLE EVALUATION TECHNIQUES

A. Processes Checklist

Monitoring student achievement in science processes may be helped by observing student behaviours in applying the processes. The student should be able to carry out the processes noted in the objectives in each science unit in the curriculum, at the appropriate grade level. A checklist from these objectives can be made, the concepts are taught, and then the process involved can be checked off for those students who show mastery. Samples of some student behaviours are:

Process	Behaviour
Observing	. Identifies properties of an object with and without sight; uses a variety of senses.
	. Selects objects according to special properties.
	. Identifies changes in an object and parts of a system.
	. Places a greater emphasis upon quantitative observation (estimating, measuring).
	. Describes motion of an object relative to a reference point.

Communicating	. Reads and constructs bar graphs, simple tables, and charts. . Interprets accurately information and instructions presented orally, in writing, and in graphic or pictorial form. . Reports information concerning an investigation; e.g., states the problem, records the results, and reaches a conclusion.

B. Scientific Attitude Checklist

Attitude	Behaviour
Questioning of All Things	. Shows curiosity with objectivity and open mindedness.
Searching for Data and Their Interpretation	. Looks for support for their ideas.
Demanding Verification	. Seeks data and information to validate observations or explanations. . Questions conclusion based on incomplete data.
Respecting Logic	. Modifies views in the face of new evidence . Shows respect for the ideas of others.

C. Performance Items

These items may be used individually or in a group (station) setting to test process and manipulative skills at the grade 3 level. For example:

Birds

Purpose: to test observing/classifying, interpreting skills.

Procedure: Pictures of two birds are provided and children are asked to see what is different about them and how they are different. Use only observable differences, i.e. colour/pattern, size/shape, environment.

Marbles in Tubes

Purpose: to test observing, inferring, interpreting data, explaining physical phenomena, safety/manipulative skills.

Procedure: Three covered tubes in upright positions, each containing liquids of different densities (i.e., water, vegetable oil, methyl alcohol) and a marble. Tell students that the marbles are all the same size and weight. have students examine the tubes and turn them upside down. Ask students to write down three things they observe and to propose a reason for the marbles taking different times to fall.

SAFETY AND SCIENCE[3],[4]

The K-4 curriculum contains few safety hazards to children. Teachers should establish proper classroom behaviour, conducive to safe operation. Common sense is the best guide to follow in the area of safety. Manageable group size and a well-planned lesson will allow students to work without confusion. By showing concern for safety, the teacher can help the students develop a positive attitude in regard to safety.

General Safety Guidelines

- At the beginning of the science class, remind the students about the applicable safety precautions they must take during the lesson.
- Give clear, complete directions before allowing the students to begin any activity.
- Instruct students not to taste or touch substances or materials without permission.
- Stress the importance of not touching one's eyes, ears and mouth while working with plants, animals and chemicals.
- Allow time for clean-up and proper storage of materials.
- Closely supervise your students at all times.
- Familiarize students with first aid, fire drill and other emergency procedures.

---

[3] "Safety in Science." Department of Education, 1982.

[4] "Safety in the Elementary Science Classroom," National Science Teachers' Association, 1742 Connecticut Avenue, N.W., Washington, D.C., 20009.

Some tips on animals and plants are:

Animals

- Check for student allergies.
- Obtain animals only from a reputable dealer.
- Keep in suitably sized enclosures.
- If animal is in poor health, remove it from the room until a veterinarian has been consulted.
- Always wash hands after handling the animal.
- Keep an animal only for as long as it is a meaningful part of a classroom program.

Plants

- Check for student allergies.
- Be aware that parts of some plants are poisonous, i.e. leaves - rhubarb, dieffenbachia;
  sap - poinsetta.
  seeds - castor beans

ATTITUDES AND VALUES

One of the greatest achievements of science is to have developed scientific methods that work almost independently of the people who are conducting the scientific investigations. Thus, children learning science must also learn many attitudes toward science such as:

- objectivity;
- open-mindedness;
- fairness;
- accuracy;
- thoroughness;
- perseverance;
- curiosity;
- creativity;
- risk taking.

The rudiments of these scientific attitudes can be learned very early in school, based on a gradual understanding, rather than direct teaching.

SCIENCE, TECHNOLOGY AND SOCIETY

School science is sometimes understood by students to be an end in itself. A science, technology and society (STS) emphasis attempts to help students understand the applications of science and how this relates to the world around them, making science much more relevant.

For the K-4 level, the major STS emphasis is the child's home, community environment; expanding to include cities, provinces and beyond.

The methods for incorporating STS are varied. One approach is to develop a science concept first, followed by applications, i.e. introduce the concept of heat insulators and later apply the concept by testing house insulation or designing ice-cube insulators. Another approach is to introduce the application first, and conclude with the basic science concept, i.e., Discuss how we keep our house warm in winter, or why do people replace old windows. This is the application of the science first and through testing materials, the students will conclude with the basic concepts of insulators.

Overall, it is suggested that STS goals should receive some 15-20% of the total emphasis. Some units and/or parts of units in the curriculum lend themselves more to STS activities and discussion than others. This guide marks some STS objectives/ activities with two asterisks (**) beside it. Teachers should feel free to find or develop their own examples.

ENVIRONMENTAL EDUCATION

Concerns for the environment have become so important that teachers need to be aware of imparting these values to children by example as well as by formal teaching. Such environmental values include:

- responsibility for living organisms;
- consideration for others;
- interaction with the environment in a responsible manner;
- concern and care for the environment.

Values taught through science education transfer well to life outside the classroom, developing environmentally alert individuals capable of making well-reasoned interpretations and motivated to taking responsibility for their decisions throughout life.

SUSTAINABLE DEVELOPMENT STRATEGIES

Sustainable development is the process of maintaining our natural heritage. It is important that students are made aware of the need for judicial use and management of our natural resources. The students are the stakeholders. They need to be informed about environmental concerns and the economic devastation which occurs due to a lack of environmental protection.

A Sustainable development strategies (SDS) emphasis in the science program will allow students to identify the areas in which environmental damage is taking place and to explore methods by which the environment can be protected. This SDS emphasis begins in kindergarten and continues throughout the entire science curriculum.

Some units lend themselves more to SDS activities and discussions than others. Teachers are encouraged to develop and foster SDS awareness whenever the opportunity arises.

This guide identifies the SDS related objectives with three asterisks(***) beside them.

PROCESS DEVELOPMENT

Processes are intellectual skills, developed and used both in science and other areas of study. When children experiment with materials and examine ideas both processes and concepts are being developed and used. Observation and classification skills are important to the development of more complex processes such as interpreting data and are therefore classified as basic processes. These basic processes should begin to develop from early experiences. Experimenting and controlling variables are termed integrated processes and can usually be more effectively learned by children in the late concrete and formal operational states. Each process, in turn, consists of a series of levels of difficulty, i.e., the process of observation varies from the skill of describing an object in terms of a single property to identifying the object in terms of its many properties. The basic processes are gradually developed from early childhood through grade four. The integrated processes are stressed at higher levels, but all processes can be informally introduced to young children through simple investigative situations presented and directed by the teacher.

It should be noted that many of the main processes often include other activities that reflect various aspects of the process:

- observing includes identifying;
- classifying includes comparing and ordering:
- communicating includes describing and graphing.

Observation

Observing is one of the basic process skills of science. It involves obtaining information about objects, situations or events using the five senses. Observation may be qualitative or quantitative in nature. Observing provides both a basis for new inferences or hypotheses and a tool for testing existing inferences and hypotheses.

Measurement

Measuring is the process of determining the dimensions or quantity of an object or event. It usually involves comparison of size, volume, mass, temperature and time using non-standard/standard units.

Classifying

This process is the grouping of objects, concepts, or events on the basis of some observable properties in order to show similarities and/or interrelationships.

Inferring

Inferring means suggesting more about a set of conditions than is observed. Inferences are based upon observed data and past experience. Inferences may evolve from both direct and indirect evidence and are modified on the basis of new evidence. An example of inference: "to infer the identity of objects on the basis of observation of shadows".

Communicating Data

This is a process that occurs between the observation stage and the interpretation stage. It usually involves the organization of "rough" data into a more compact and meaningful way (ordering, comparing), depicting the data pictorially or graphically, and processing data mathematically (averaging, finding slopes) in order to facilitate interpretations.

Predicting

Predicting is a forecast about future events based on previously obtained data. Predictions can be made on the basis of ordered data or extrapolation beyond an observed pattern of events. An example of prediction: "to predict the consequences of changes in an animal habitat".

Hypothesizing

Hypothesizing is an educated guess about an expected relationship between two variables in an attempt to explain a cause and effect relationship. The hypothesis should be testable.

Recognizing and Identifying a Problem

This process involves recognizing and focusing on a problem that can be investigated, making assumptions about possible variables, and the ability to narrow down the question under investigation in order to work towards a solution.

Identifying and Controlling Variables

This process involves deciding which variables will influence the outcome of an experiment or event and deliberately controlling all recognized variables in a systematic manner. This combination of relationships (system) consists of a manipulated (independent) variable which is changed in a systematic way, corresponding changes in an observed responding (dependent) variable and all other variables are held constant (controlled). An example is a pendulum system where the time of swing (responding) is affected by the pendulum length (manipulated) and other variables such as mass of the bob and arc of the swing are kept constant.

Designing an Experiment

Experimenting is a cause and effect test between two variables. All processes may be involved. This may begin with setting a problem to be solved identifying a variable to be controlled, making operational definitions, devising the test to be carried out and finally to follow the prescribed procedure.

Interpreting Data

Interpreting is the process by which sense is made out of the observations in the form of inferences, generalizations or explanations. Thus, selecting data which supports inferences, identifying a general trend, and stating a conclusion or relationship are integral parts of this process. An example is: "state the average growth rate of bean plants."

Operationally Define

This is a process whereby objects or events are defined in a way which can be tested or observed such as: "When I join copper wires, a bulb and a dry cell in this way, a bulb will light up.

Using Space/Time Relationship

All objects occupy points in space at a given point in time. This process concerns spatial relationships and the ability to describe such things as shape, symmetry, direction, position and spatial arrangement, and speed.

PROBLEM SOLVING

Problem solving is a familiar teaching/learning approach which lends itself to science teaching. Problem solving includes:

- recognizing problems;
- discussing or thinking about solving them;
- trying out one solution;
- assessing the effectiveness of the solution;
- possibly modifying the solution in the light of experience.

The approach can be used to help children understand the world of human endeavours through practical problem-solving activities, involving using and discovering science skills in conjunction with "design and make" activities.

Problem solving exercises can vary considerably in content and in the processes and strategies employed:

- exercises which are of a technological nature where children are asked to design, construct, test and evaluate a system;

- exercises designed to carry out a scientific investigation;

- decision making exercises where children discuss a problem and come up with their own solution (role playing, games, simulations).

Preferences should be given to activities that involve a problem-solving approach and which:

- encourage creativity and inventiveness in designing and making 3-dimensional models which achieve a given task;

- cause students to learn or reinforce concepts relating to energy, materials and their properties, structures, forces, speed, measurement, accuracy, stability and control;

- give opportunities to develop manipulative skills with simple tools and range of materials;

- develop communication skills within and between teams and adults including drawing and display of ideas and achievements;

- involve some element of planning and organization.

Problem solving should be a regular part of the science program. This guide marks problem-solving objectives/activities with one asterisk (*) beside it.

SCOPE AND SEQUENCE

Process Development: When a process is introduced at an early stage, it should be developed and maintained in subsequent years.

PROCESS/GRADE	K	1	2	3	4
Observing	I	D	D	E	E
Measuring	I	I	D	D	E
Classifying	I	I	D	E	E
Inferring	I	I	D	E	E
Communicating	I	I	D	D	E
Predicting	I	I	D	D	E
Recognizing a Problem	I	I	D	D	E
Controlling Variables			I	I	D
Hypothesizing				I	D
Interpreting Data			I	I	D
Operationally Define			I	D	D
Design Experiments			I	I	I

Note:

I - Introduce processes using primarily teacher input.
D - Develop processes with less teacher input.
E - Extend processes to become more student controlled and directed.

38

ATTITUDE DEVELOPMENT

When an attitude is introduced at an early stage, it should be developed and maintained in subsequent years.

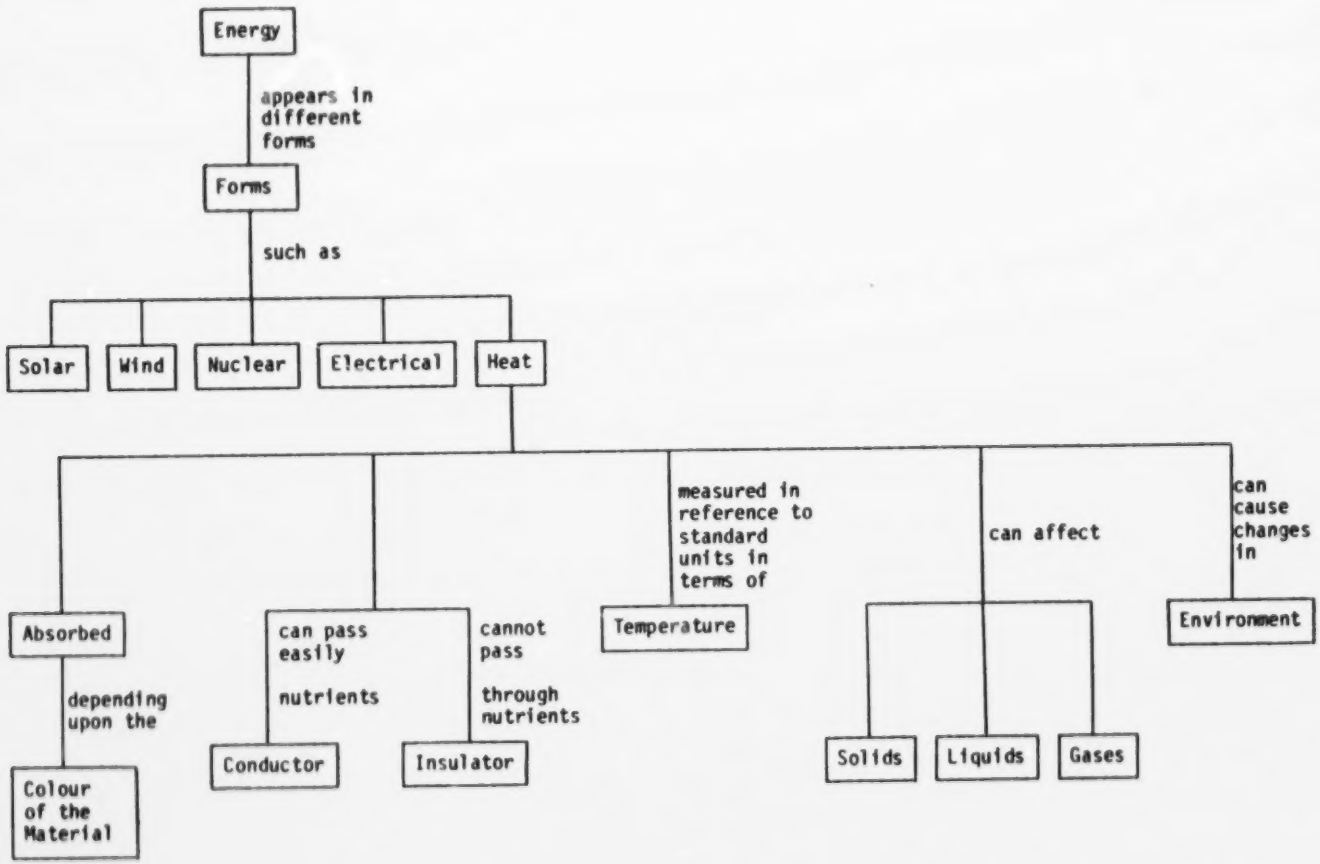
ATTITUDE/GRADE	INTRODUCTORY GRADE
Appreciate all living things.	K
Be committed to good animal care.	1
Be aware that animals can cause allergic reactions.	1
Value differences and similarities among humans.	1
Appreciate the adaptive value of some animal behaviours.	3
Recognize the need for safety in all activities.	K
Recognize the need for standard units and references.	1
Appreciate the need for verification.	1
Develop curiosity about natural events.	2
Recognize the need for accuracy in measuring.	2
Recognize that predictions can be made as a bais of valid evidence.	2
Seek plausible hypotheses to interpret findings.	4
Recognize the need for an empirical test as a basis for judging hypotheses.	4
Respect the importance, order, and beauty of the environment.	2
Recognize the need for man's care of the environment.	2
Recognize the importance of uses of different energy sources.	3
Develop an interest in learning about the universe.	3
Recognize the need to control sound in the environment.	4
Appreciate the technology of communication.	4
Appreciate the technology of electricity.	4
Appreciate the power of geological forces.	4
Recognize the dependence of man upon geological forces.	4
Recognize the importance of water as a resource.	4
Recognize the need to control and handle water wisely.	4

General Program Overview

THEME	K	1	2	3	4
Inter-Dependency and Interaction	Living and Non-Living Organisms	Animals are Living Organisms --- People are Living Organisms	Living Organisms in the Environment	Life Cycles	Population Interaction
Matter and Energy	Properties of Objects	Properties of Matter	Flotation: A Property of Matter	Energy, Heat and Temperature --- Changes in Matter	Electricity --- Structures --- Sound
Earth, Time and Space	Size, Position and Time	Comparing and Measuring Events	Light and Shadows --- Measuring Time, Objects and Position	Sun, Earth and Moon --- Air and Air Pressure	Water and Land

GRADE THREE

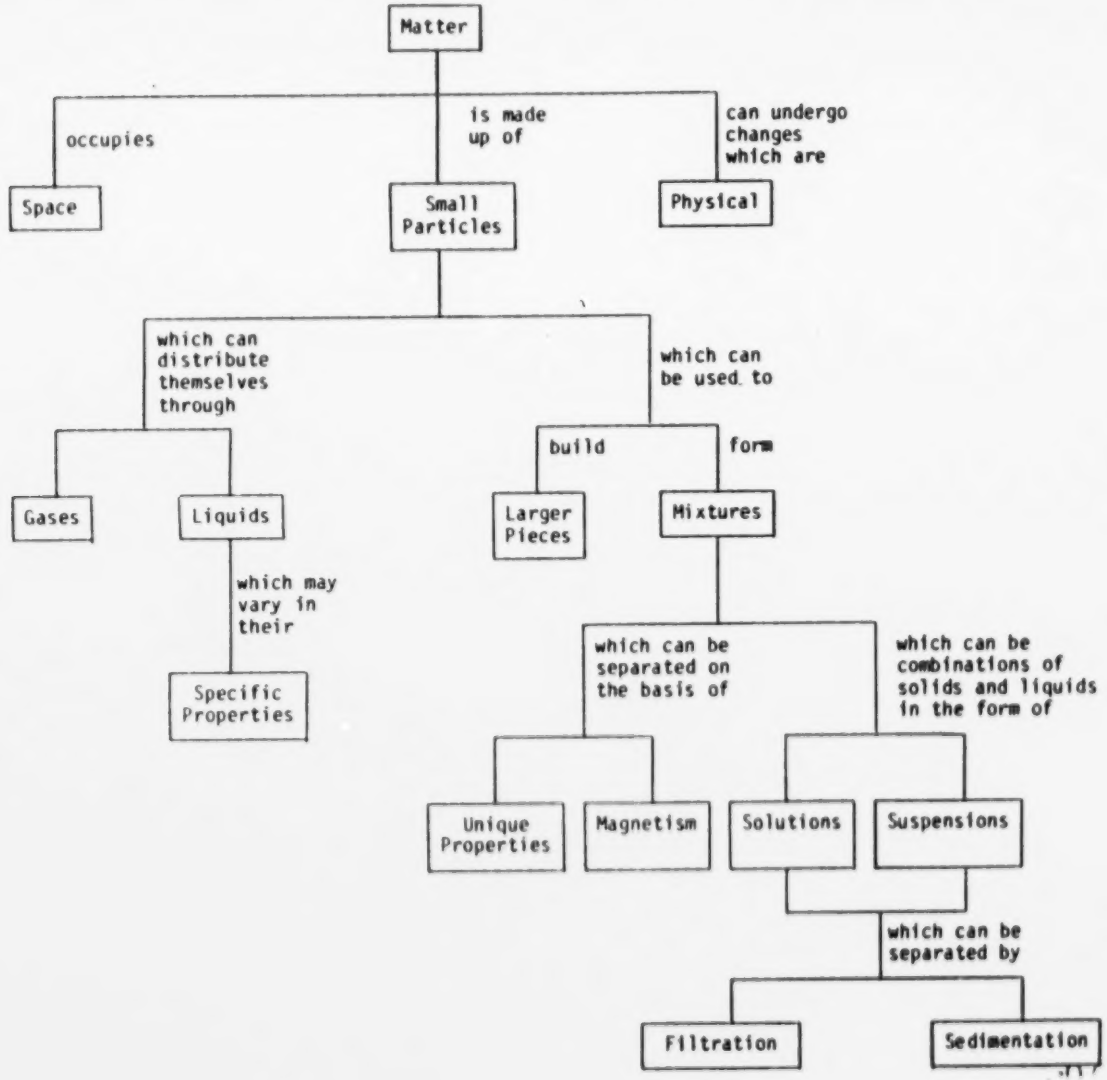
CHANGES IN MATTER AND ENERGY: ENERGY, HEAT, TEMPERATURE



BEST COPY AVAILABLE

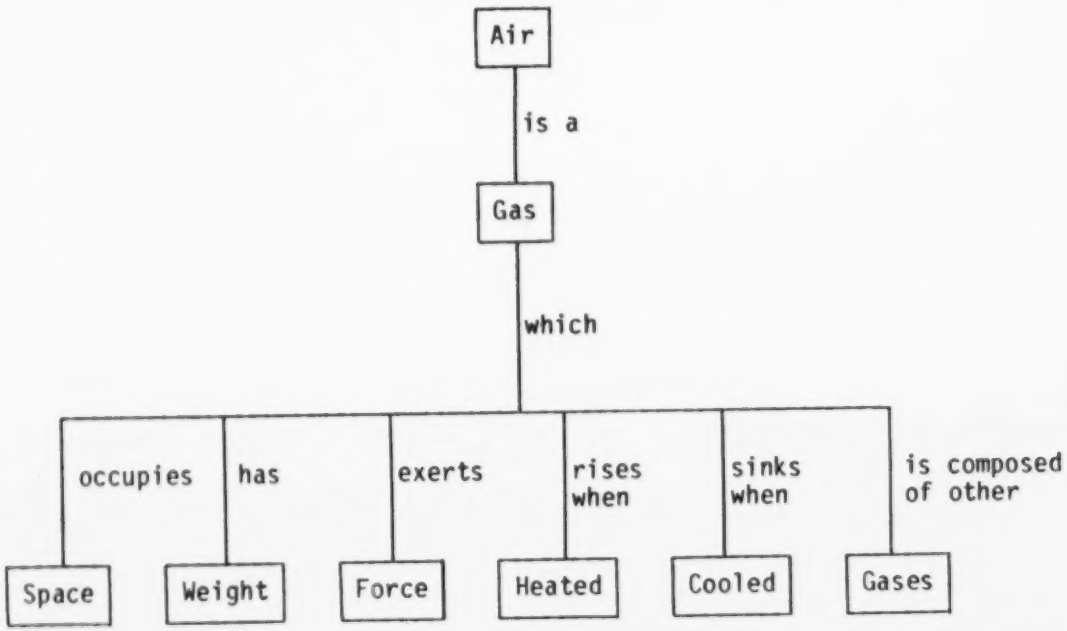
GRADE THREE

CHANGES IN MATTER AND ENERGY: CHANGES IN MATTER



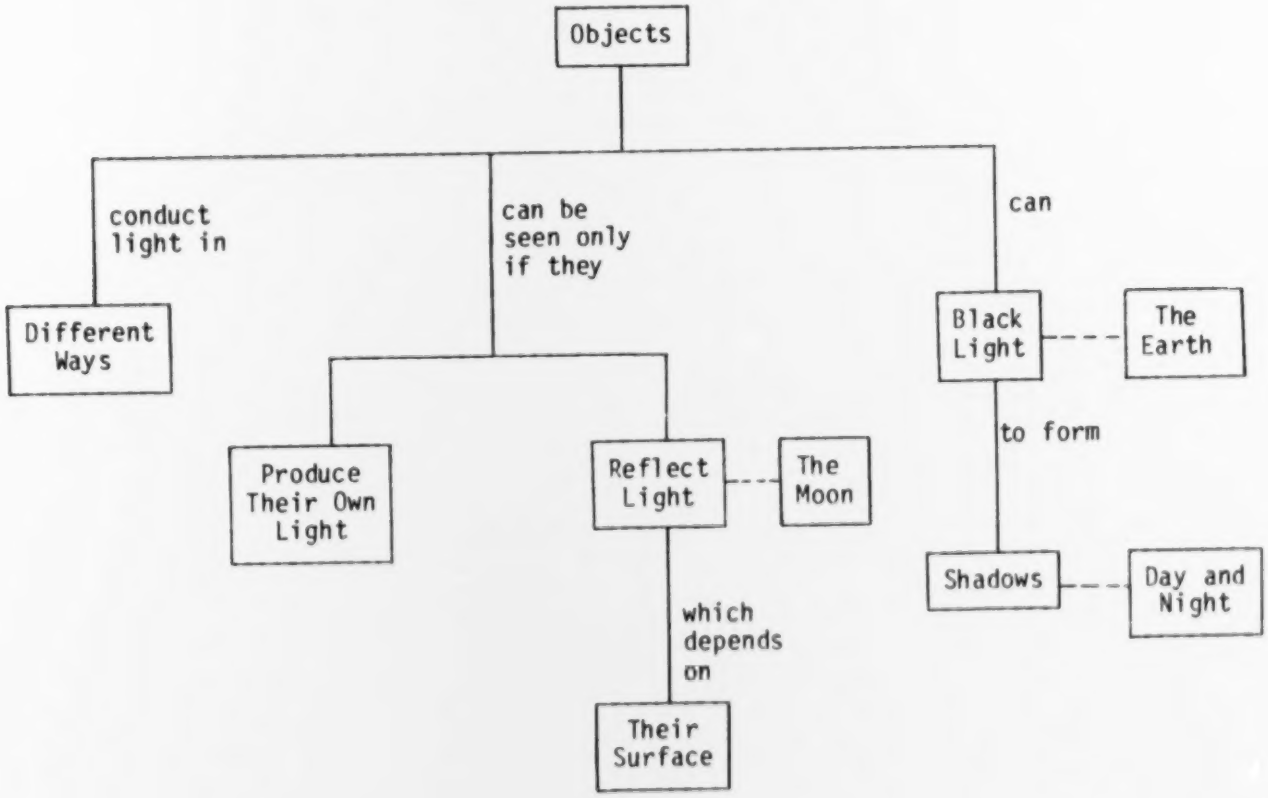
GRADE THREE

CHANGES IN MATTER AND ENERGY: AIR AND AIR PRESSURE



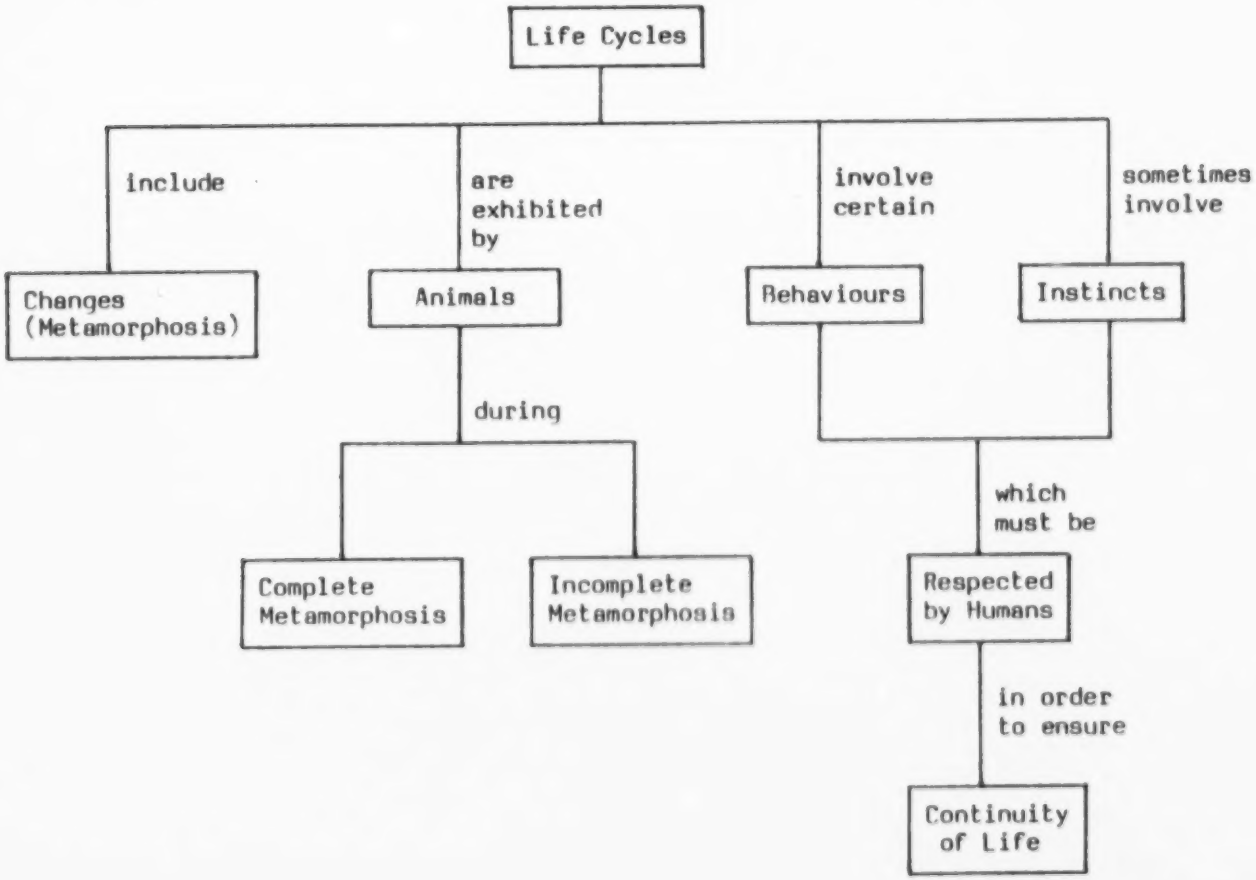
GRADE THREE

EARTH, SPACE AND TIME: THE EARTH, SUN AND MOON



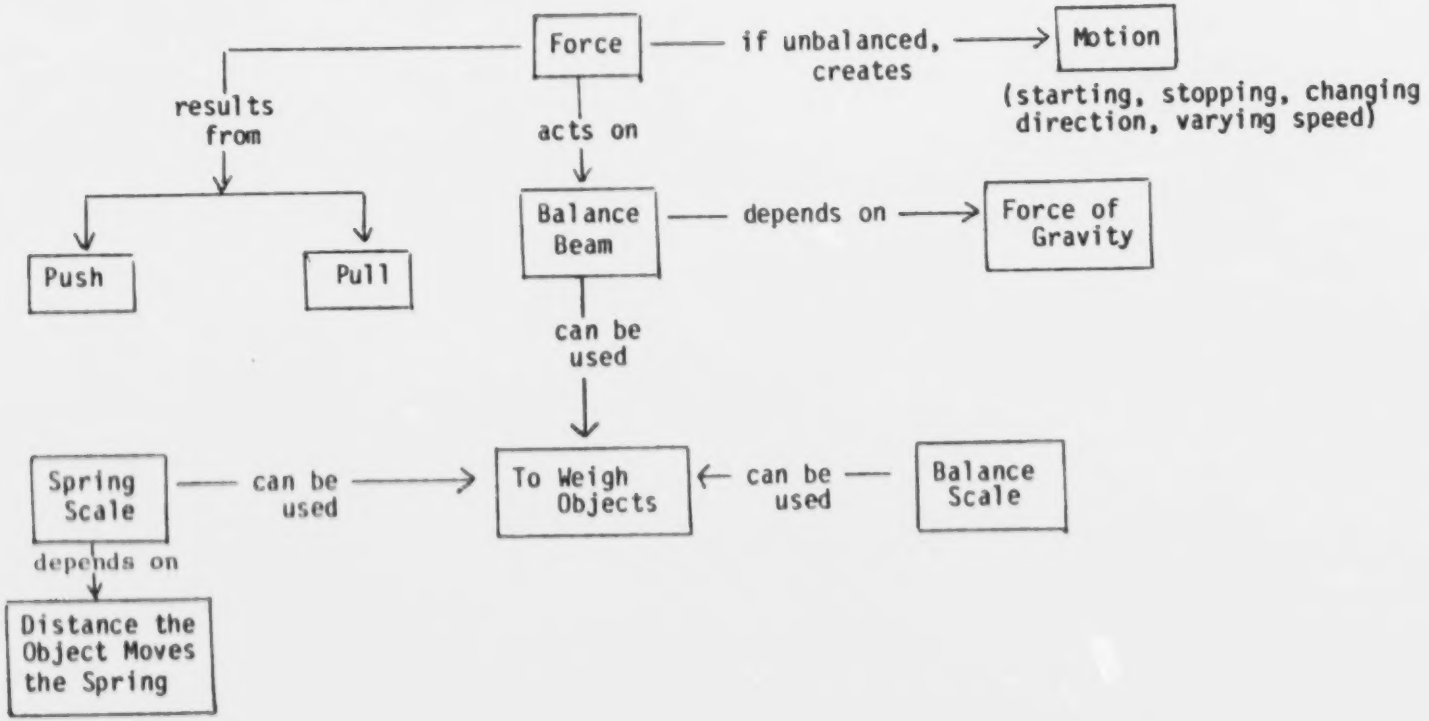
GRADE THREE

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: LIFE CYCLES



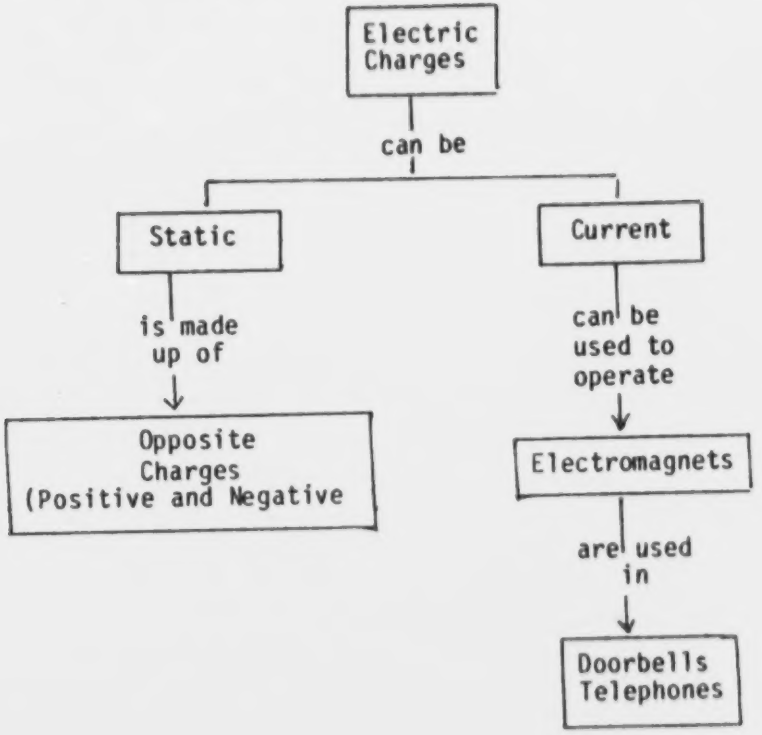
GRADE 5

CHANGES IN MATTER AND ENERGY: FORCE AND MOTION



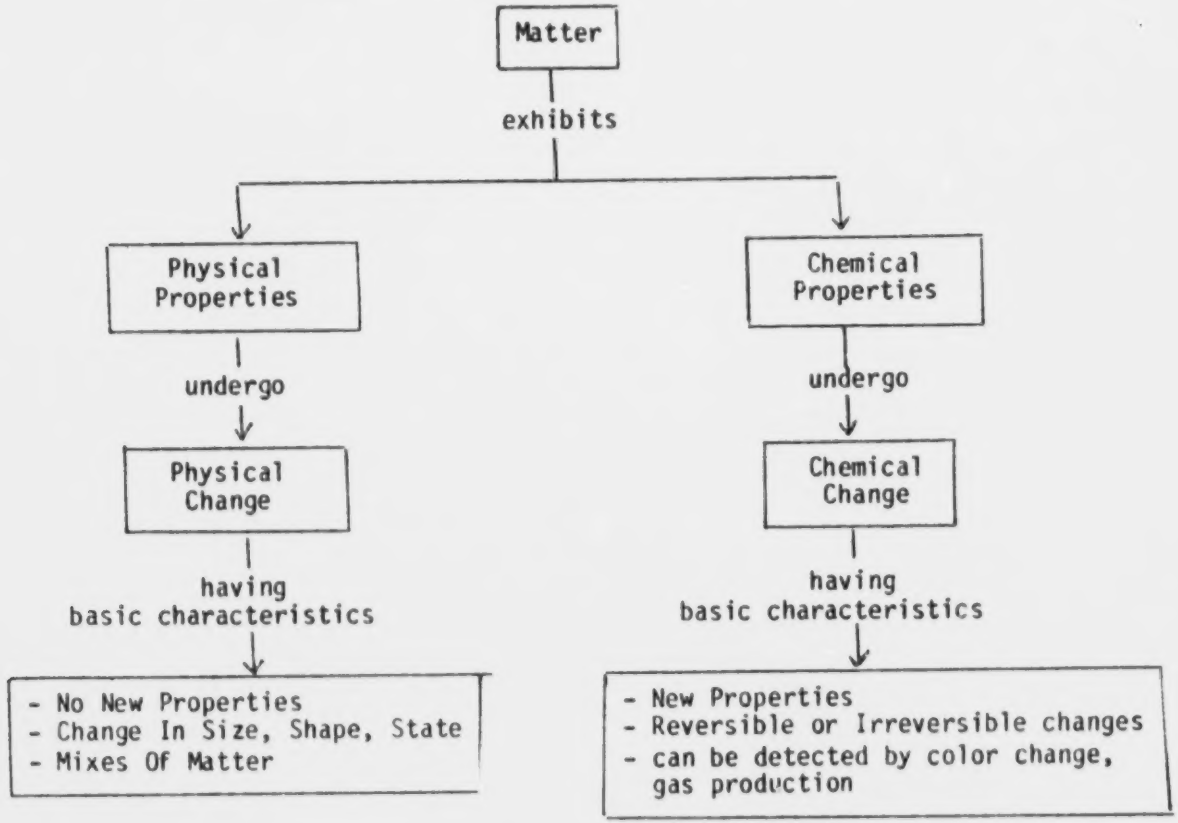
GRADE 5

Changes In Matter and Energy: Electric Charges



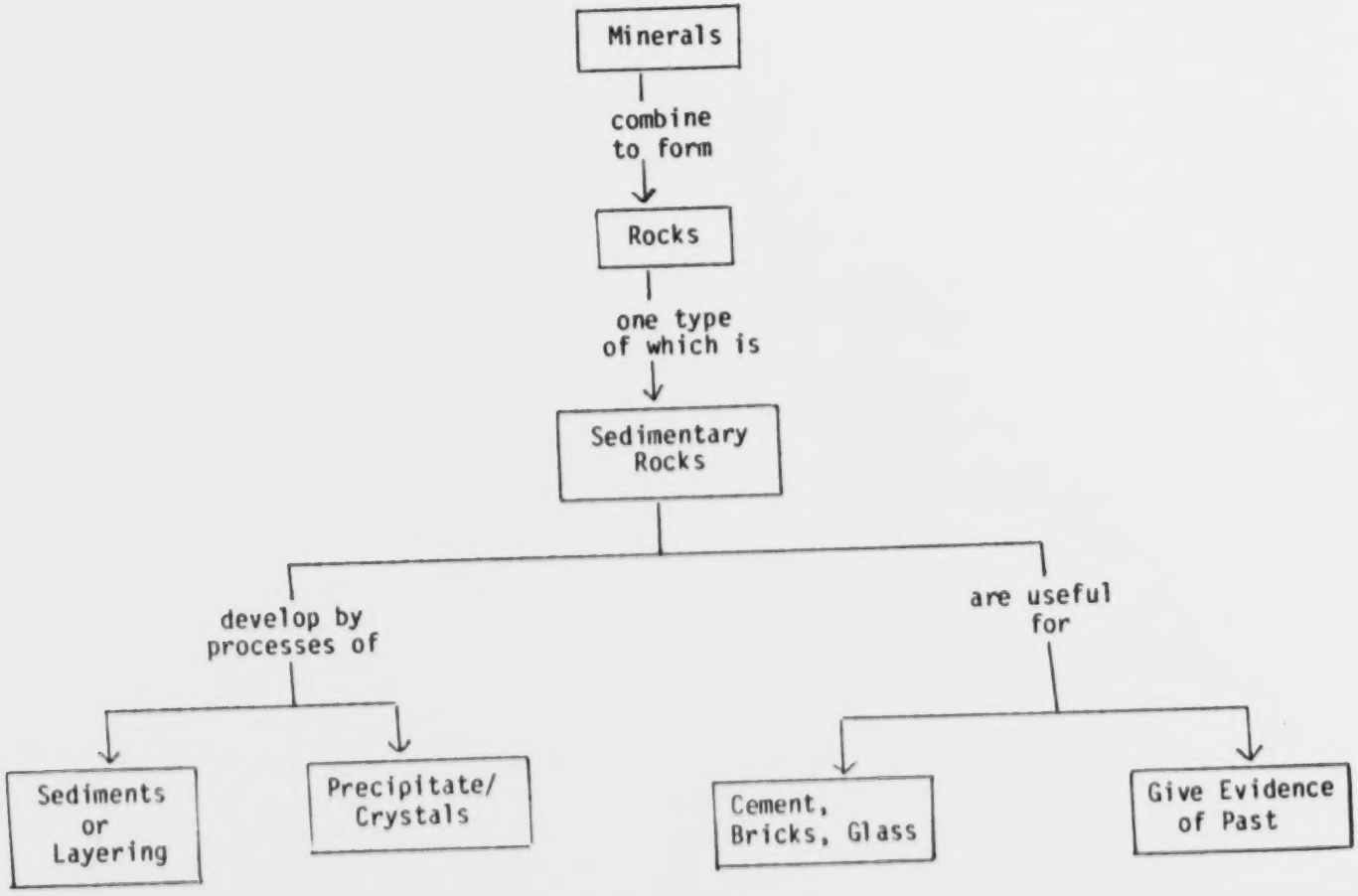
GRADE 5

CHANGES IN MATTER AND ENERGY: PHYSICAL AND CHEMICAL CHANGES



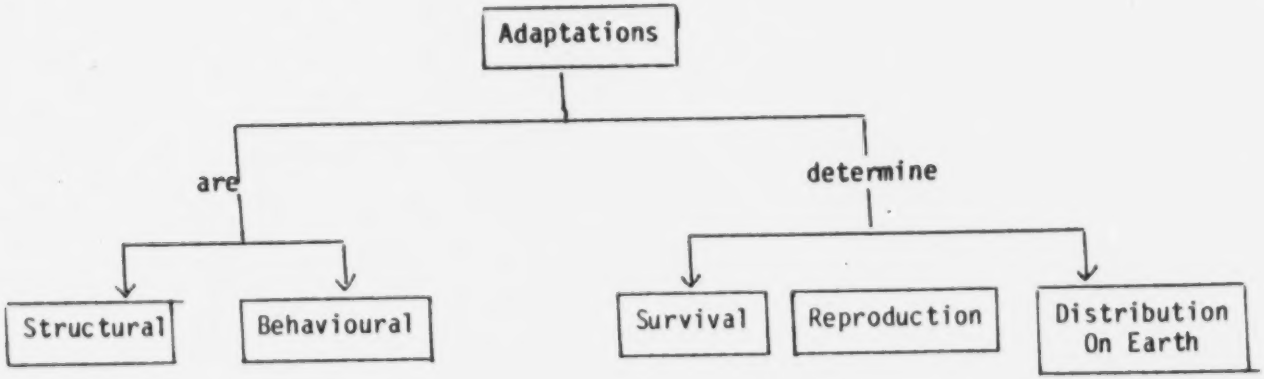
GRADE 5

EARTH SPACE AND TIME: THE CHANGING EARTH



Grade 5

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: ADAPTATIONS TO THE ENVIRONMENT



MATERIALS LIST

This is a suggested minimum list for the K-4 Science program. Many other items should be readily available at school or in the home. Teachers should be advised to review the units so that locally available material may be obtained in advance. A petty cash fund needs to be available in order that purchases may be made on an ongoing basis.

Basic Materials

- pop bottles (glass)
  (plastic - 500 ml, 1 litre, 2 litre)
- plastic containers and lids in all sizes
- egg cartons
- trays of assorted sizes
- cloth of all textures, colors, and materials
- nylons and panty hose
- newspaper
- jars of all sizes with lids
- tin cans of all sizes
- pine cones, bark, twigs
- popcorn kernels
- food colouring
- a variety of woods
- a variety of sandpaper
- coins
- milk cartons
- alka seltzer tablets
- sponges
- assortment of food and cooking items
- crackers, orange juice crystals, detergent, spaghetti, macaroni, salt, sugar, sugar cubes, baking powder, vinegar, flour, syrup, cornstarch, vegetable oil, molasses, dish detergent.
- popsicle sticks
- large and small graph paper
- wax (paraffin wax)
- vegetable oil, molasses, dish detergent
- an assortment of string
- an assortment of wool
- waxed paper
- aluminum foil
- plastic wrap
- paper towels
- kettle
- pie plates styrofoam and tin
- insulated wire (copper)
- toilet rolls
- gravel
- sand
- ping pong balls
- cardboard of all sizes and thickness
- plastic combs
- tooth picks
- cereals
- cotton balls
- threads
- an assortment of nails
- fossils (plastic models can be purchased)
- pulleys single and double
- index cards
- pictures
- balloons
- latex gloves
- straws
- spoons
- elastic bands
- thumbtacks
- paper clips

- straight pins
- candles
- dry cells
- light bulbs (miniature)
- scale (kg)
- magnets
- magnifying glasses
- fixed pan balance
- aquarium
- variety of seeds
- plasticine
- meter stick
- tape
- tape measure
- weights (g)
- graduated cylinder
- beakers
- medicine droppers
- test-tubes
- thermometers
- rubber stoppers
- corks
- glass tubing
- filter paper
- marbles
- baggies
- paper towels
- mirrors
- steel wool
- washers
- styrofoam cups
- paper cups
- clock (with second hand)
- markers
- drinking straws

SPECIFIC MATERIALS

Kindergarten

1. attribute blocks
2. terrarium
3. bulbs (for planting)
4. soil

Grade One

1. attribute blocks
2. logic sets (trees, vehicles, etc.)
3. egg beater
4. metronome (if available)
5. graph paper
6. bathroom scale

Grade Two

1. graph paper
2. 30 cm. ruler
3. flashights (different sizes)
4. light bulb and socket
5. chart paper

Grade Three

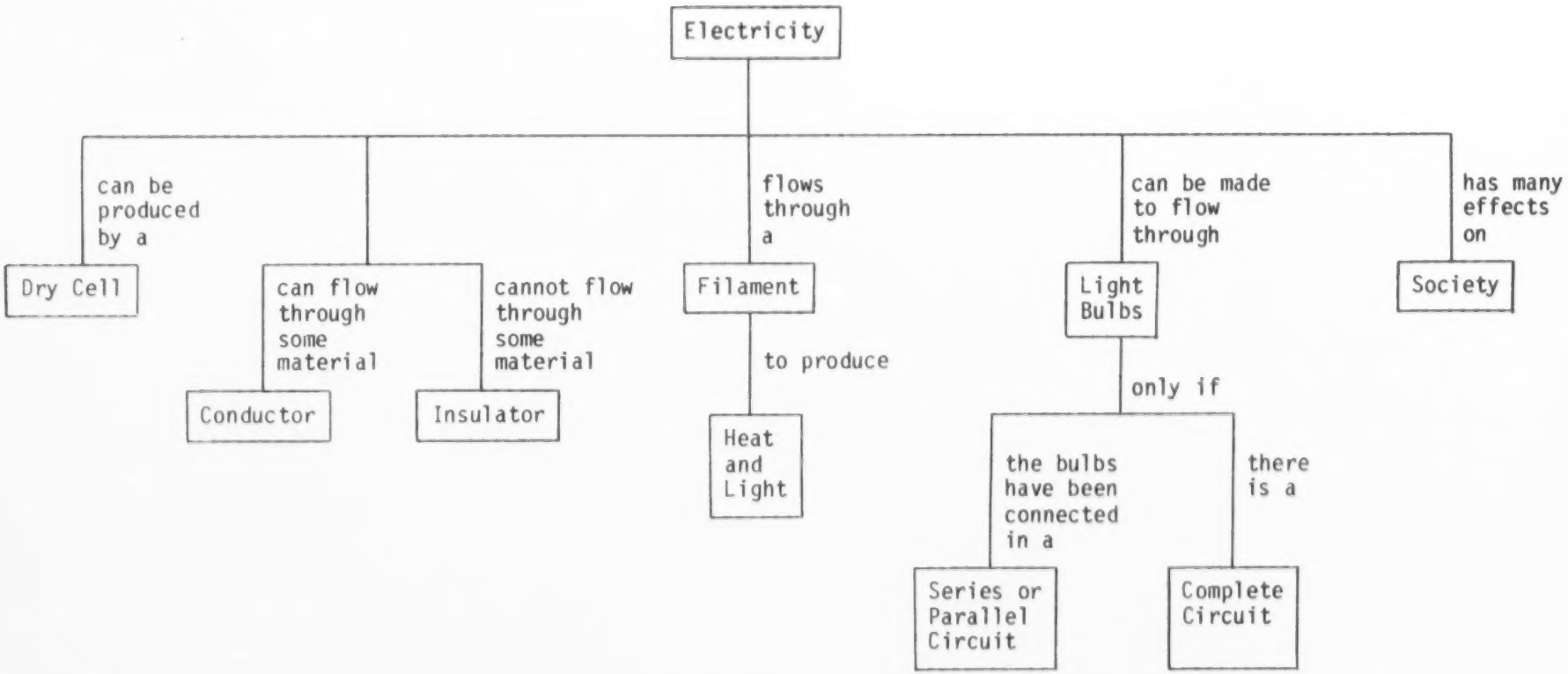
1. light bulb and socket
2. ball and ring apparatus
3. rubber tubing
4. meal worms
5. beetles
6. earthworms
7. glass flask
8. wax (paraffin)

Grade Four

1. nichrome wire
2. sockets (for miniature light bulbs)
3. alligator clips
4. fine steel wool
5. tuning fork
6. slinky
7. ticking clock
8. microscope slides
9. cover slips
10. microscope
11. prepared animal cells
12. iodine
13. skeleton set

GRADE FOUR

CHANGES IN MATTER AND ENERGY: ELECTRICITY



GRADE FOUR

TITLE: CHANGES IN MATTER AND ENERGY: ELECTRICITY

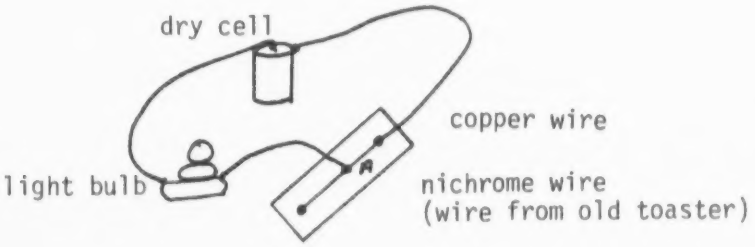
RATIONALE: Through the use of process skills, children will understand simple electrical circuitry, insulators and conductors, and the role they play in society.

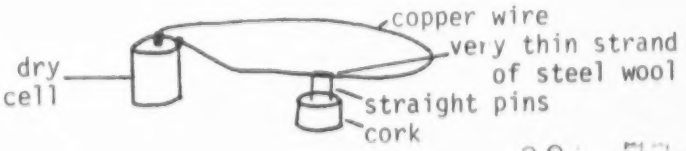
MAIN CONCEPT(S):

* Refers to problem solving
** Refers to STS
*** Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. A dry cell (hereinafter called a cell) can be a source of electricity. The path through a bulb, cell, and their connecting wires is called a circuit.	a) Predict the ways in which a single bulb can be lit using one cell.	SAFETY Use of low voltage and amperage cells is necessary. Have students test their predictions using one cell and one wire, then one cell and two wires. Record results.
2. Electricity cannot flow if there is a gap in the circuit. A switch can either open or close a gap thereby controlling the flow of electricity.	a) Observe how a switch affects an electrical circuit.	Design and construct simple circuits and switches using simple materials.
3. Several cells connected can make a bulb light up more brightly.	a) Observe the various ways in which several cells can be joined to one bulb.	SAFETY Advise students to avoid leaving bulbs burning for long intervals in order to prevent unnecessary burn out.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
Cells can be connected in two basic ways: series or parallel.	b) Predict and test which method will give the brightest light.	Construct a series and parallel circuit and record results.
4. Several bulbs can be connected to one cell in two basic ways: series or parallel.	a) Observe and test the number of bulbs which can be lit in a series circuit; in a parallel circuit.	Construct a series and parallel circuit and record results.
	b) Predict the effect of removing one bulb from a series, and parallel circuit.	Test the effect and record results.
5. Some materials are conductors, some are insulators.	a) Compare materials which conduct or insulate.	Use ceramic, rubber, copper, aluminum, nichrome, etc. Observe the brightness of the light bulb in each case. Do not keep the dry cell connected for more than a short interval.
	b) Classify materials as either insulators or conductors of electricity.	ENRICHMENT Infer that adding a longer resistor affects brightness.

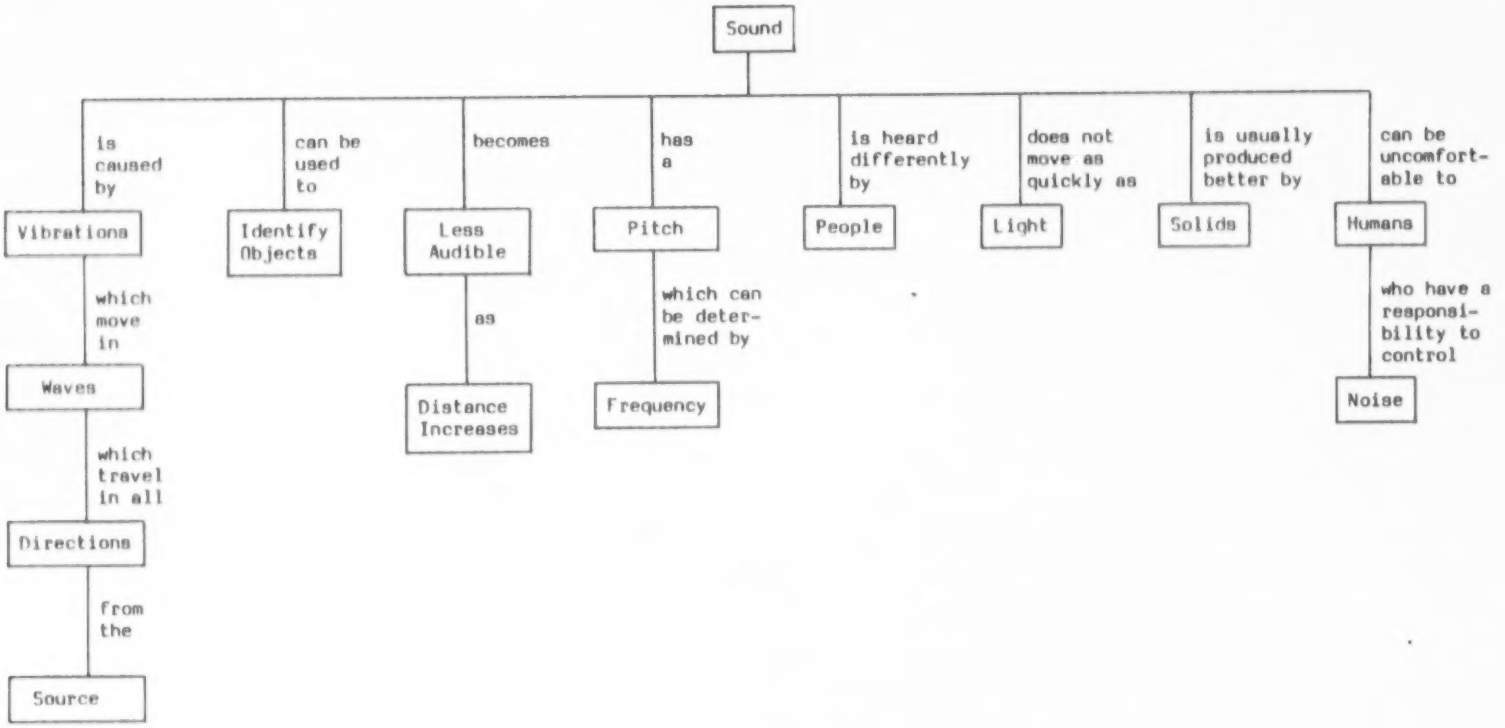


CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
		Change contact point of copper wiere at "A" to different poisitions along nichrome wire and record brightness of bulb. Use an alligator clip to make contact at position "A".
		ENRICHMENT Predict the effect on a circuit as the length of wire is increased.
		ENRICHMENT Infer that lengthening the wires in a circuit will increase resistance. Build a variastat control.
		ENRICHMENT List devices that use resistance to control electricity.
6. The flow of electricity through the filament in a bulb heats the filament and produces light.	a) Observe and diagram the structure of a light bulb.	Demonstration: Carefully remove the glass from a light bulb and show students the working parts of the bulb.
	b) Infer that the filament in a flashlight bulb is part of the circuit.**	Have students construct a model of a light bulb.
	c) Operationally define a light bulb.	

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
7. Electricity has many effects on society.	a) List ways that electricity has been beneficial to society.**	ENRICHMENT Research how hydro power is produced.
	b) Recognize possible ways that electricity has negatively affected the environment.** ***	ENRICHMENT Discuss: dams on rivers--flooding; hydro paths; hydro lines--birds.

GRADE FOUR

CHANGES IN MATTER AND ENERGY: SOUND



GRADE FOUR

TITLE: CHANGES IN MATTER AND ENERGY: SOUND

RATIONALE: Through the use of process skills, children will begin to understand air and air pressure and what effects they have in our daily lives.

MAIN CONCEPT(S): Energy transferred from one particle to another creates sound.

* Refers to problem solving
** Refers to STS
*** Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. Sounds can be used to identify objects.	a) Infer the identity of an object using only the sense of hearing.	Listen to taped sounds and identify the source.
	b) Infer the nature of an object or event from familiar sounds.	Note: Unfamiliar sounds cannot be recognized.
	c) Identify the direction from which sounds are produced.	Play variations of "Blind Man's Bluff."
2. People vary in the way in which they can hear and identify sounds.	a) Recognize that we can eliminate the effect of sound when we concentrate on something other than the sound.*	ENRICHMENT Discuss fair tests and design a hearing test. Test in a quiet area, then a noisy area.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
3. Sound is caused by vibrations. A vibration is a regular to- and fro-motion.	a) Infer that most vibrating objects cause sound.*	ENRICHMENT Research and develop methods to tune home-made instruments such as xylophones, drums, guitars, shakers, tubular balls, column water bottles.
	b) List some objects that make movements that you can see as they make sounds.	Make sound scoop out of a styrofoam cup.
	c) Observe the grooves in a record.	
	d) Infer that the grooves in a record produce sound.	ENRICHMENT Research first record player.
	e) Design and construct an instrument that uses vibrations to make sound.*	
	f) Appreciate the technologies of communication.**	
4. The pitch of a sound is determined by the number of times an object vibrates in a given period of time (frequency).	a) Measure the lengths of the vibrating object and relate the length to the pitch.	Look inside a piano or other stringed instrument. Discuss which strings cause high/low sounds. Place a number of rubber bands of different lengths around a wooden or cardboard box and strum the bands. What do you notice).
	b) Infer that pitch is related to the length of a closed column.	Fill eight glasses or bottles with increasing amounts of water. Tap the rim of the glass with a nail or pencil and note the pitch of each glass. Blow across each bottle and note the changes in pitch.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	c) Control the variables which affect the pitch of sounds.	Use different lengths of large drinking straws with flattened ends. Blow through the straws and make a musical scale.
	d) Operationally define frequency.	Construct a washer pendulum using a washer and different lengths of string. Record the number of swings per minute.
5. Sound vibrations move in waves and travel in all directions from the source.	a) Infer that sound vibrations travel in waves.	Use a "slinky" as a model to show how sound waves travel. Put a vibrating tuning fork in a pan of water.
	b) Observe that you do not have to be in the direct line of a sound in order to hear it, but the sound will be less audible.	Have students stand back to back and ask each in turn to speak or have students talk to each other from around corners.
6. Sound waves become less audible as they move further from the source.	a) Observe that sound waves become less audible over great distances.	Have students walk away from a ticking clock until they can no longer hear it.
	b) Observe that sound waves can be heard more easily over great distances when the waves are confined.	Have students listen for the ticking clock using the tubes from Christmas wrap. Join the tubes with masking tape. Compare the distances using the above two systems.
7. Sound does not move as quickly as light.	a) Observe that sound requires measureable time to travel between 2 points, while light appears to be instantaneous.	Observe thunder and lightning. Observe the starter at the track and field meet and note that the smoke from the starting pistol shows before the sound arrives. Have a student stand 100 m from the school building and bang two blocks of wood together. The students will observe that the blocks of wood hit together shortly before the sound is heard.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
8. Solids generally conduct sounds better than liquids or gases, such as air.	a) Observe the intensity of sound through solids, gases and liquids.	Fill plastic bags with different substances, e.g., a book, water, air, a piece of iron, etc. Hold a ticking alarm clock up against the bags (keep the clock the same distance away from the ear). Cover the other ear and see which substances best transmit the sound.
	b) Construct a tin can telephone and list the variables that can be tested. Predict the results.	String - nylon, wax coated cord cotton, - different thicknesses. Cans - plastic, tin, paper, glass. Voices - different pitches, loudnesses.
	c) Test and order the variables by effectiveness.	
	d) Discuss the use of fibre optics in communications.**	Have representatives from the Manitoba Telephone System bring samples and discuss fibre optics with the class.
9. Loud sounds can be uncomfortable and even unhealthy.	a) List sources of loud sounds and order by comfort level.	Discuss noise pollution such as that caused by jack hammers, lawn mowers, etc.
	b) Identify examples of noise pollution and infer ways of reducing noise pollution.**	
10. Humans have a responsibility to control people-made noises.	a) Observe the environment using the sense of sound.**	
	b) List ways humans protect themselves against noise.**	Develop ways to better insulate your home or classroom against sound. Develop a list of such things as ear plugs, acoustic tile, insulated cabs, etc.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES

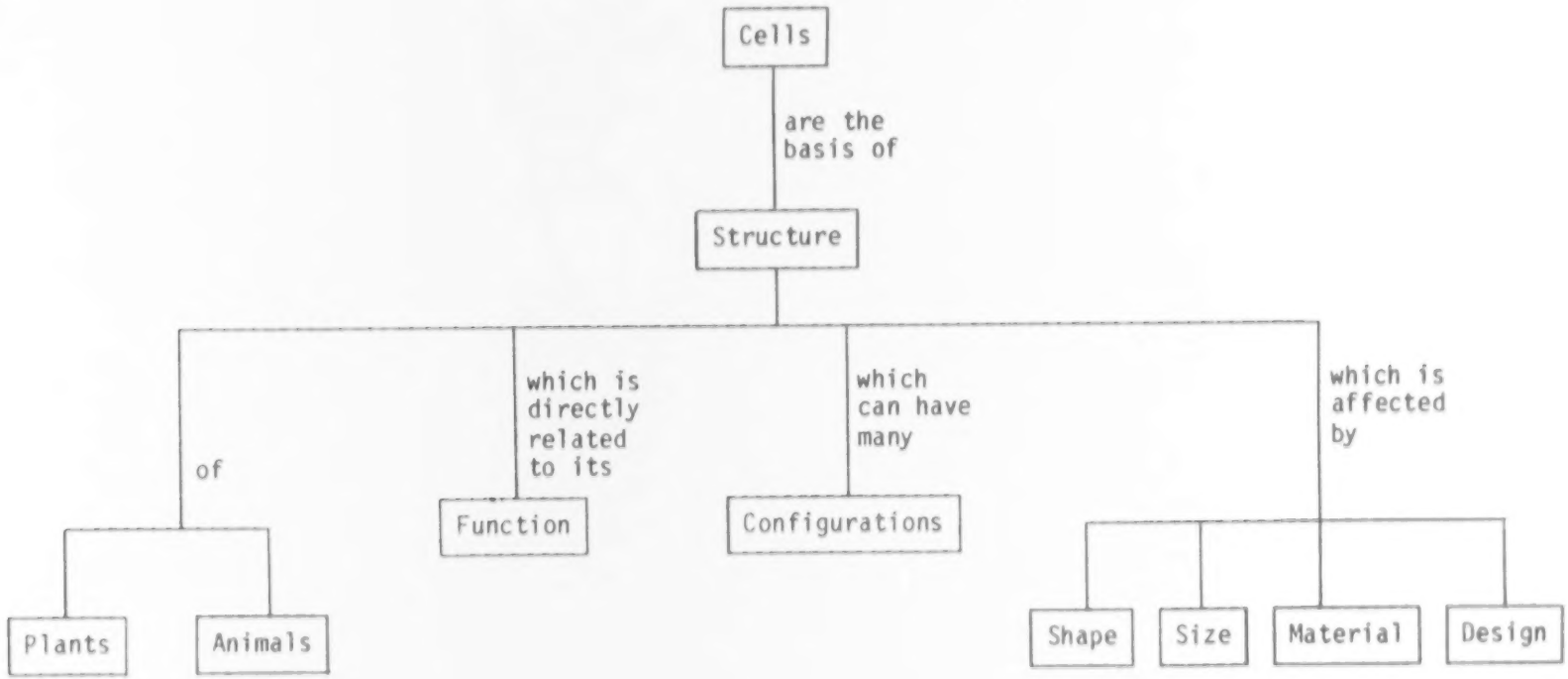
c) Construct a cover for a tape recorder that will best stop sound.*

90

91

GRADE FOUR

CHANGES IN MATTER AND ENERGY: STRUCTURES AND FUNCTIONS



GRADE FOUR

TITLE: CHANGES IN MATTER AND ENERGY: STRUCTURES AND FUNCTIONS

RATIONALE: Through the use of process skills, children will develop a realization that the structure of all living and non-living things is determined by its function.

MAIN CONCEPT(S): All living things are made up of cells. Their structure is determined by their functions.

* Refers to problem solving
** Refers to STS
*** Refers to SDS

Note: This unit fits into the autumn season and contains sections which can be correlated with the Art program, e.g., skeletons and Halloween costumes.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. Plants are made up of cells.	a) Using a microscope, observe cells in an onion skin or other plant cells.	
	b) Observe and record cells of a peeled onion.	Take a thin section of the membrane found between the rings of an onion and place it on a microscope slide. Place a drop of water on the sample and gently lower a cover slip over it. Draw the cell structure as observed by means of the microscope.
	c) Compare onion skin cells to bricks.	
	d) Describe how cells, like bricks, build a structure.	
2. Animals are made up of cells.	a) Using a microscope, observe prepared animal cells.	Obtain commercially prepared slides of muscle tissue, cheek cells, etc.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	c) Compare animal cells to onion skin cells.	Use diagrams, sketches, prepared slides, etc.
3. All living things are made up of one or more cells.	a) Define cell (basic unit of life).	
4. Cells have structures and exhibit characteristics of living things i.e. get food, grow and reproduce, respond to stimuli such as temperature changes and light.	a) Identify and name the cell wall, cell membrane, cytoplasm and nucleus of a plant cell.	Have students make drawings and label the parts. Have them "act out" a cell by joining hands for the membrane.
	b) Construct a model of a cell.	Use cotton batting for the cytoplasm, plasticine for the nucleus, Petri dish or baggie for the membrane. An egg can be used as a cell model. The boiled egg illustrates the membrane wall very well.
	d) Recognize and list the characteristics of a cell.	ENRICHMENT Study and research single-celled organisms (yeast, protozoans from pond water).
5. The structure of an object is directly related to its function.		
i) external	a) Observe the outside of fruits and vegetables for its structure.	Collect a variety of fruits and vegetables. Cross-cut each to show skin thickness, texture, colour, and other properties.
	b) Classify and list types of skins.	Classify by properties that have been identified.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	c) Infer reasons for differences among skins.	Consider such things as protection of seeds or pulp, ability to retain moisture, attract agents of seed dispersal.
ii) internal	a) Observe the inside of fruits and vegetables.	Make cross-cuts of watermelon, orange, carrot, cucumber, pineapple, grapefruit or anything that is available, i.e., acorns, wild berries, cattail roots, etc.
6. Structures have many different configurations.	a) Observe and list different configurations.	Layered (apartment blocks), ringed (tree), boxed (cells), angular honeycomb, bubbles.
	b) Infer the function of each type of configuration.	Infer the age of a tree by its growth rings.
7. Skeletons are structures. They can be endoskeletons or exoskeletons.	a) Observe different types of skeletons.	Use pictures, fish carcasses, Halloween skeletons. ENRICHMENT Put together a skeleton set and compare to a model car set.
	b) Infer that skeletons are structures.	
	c) Classify skeletons into endo and exo.	Note: All vertebrates have endoskeletons. (Your list should include turtles.)
	d) Discuss the functions of each type of skeleton.	Chart the advantages and disadvantages of the skeletal structures of various creatures.

BEST COPY AVAILABLE

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	e) Compare people-made designs with natural ones.**	Use a picture file to show comparisons between each of the following pairs: falcon - jet jelly fish - parachute squid - rocket turtle - tank hummingbird - helicopter webbed feet - swim fins skunk smell - tear gas thorns - barbed wire snake poison - poison darts spider's web - fish net
8. Size and material affect structures of animals.	a) Observe the bones of birds and compare them with bones of land animals.	Construct skeleton kits. Collect old bones to create unique individual skeletons. Glue the bones together, e.g., mouse skeletons in owl pellets; chicken bones, etc.
	b) Infer that the structure and porosity of bird bones aid flight.	Examine chicken, goose and duck bones if available.
	c) Observe the relationship between the size of bones and the size of the animals.	ENRICHMENT Research the size of dinosaur bones in relation to the dinosaur's size.
	d) Compare bone to other materials to infer that bone is strong yet light.**	Compare to wood, steel, glass and plastic.

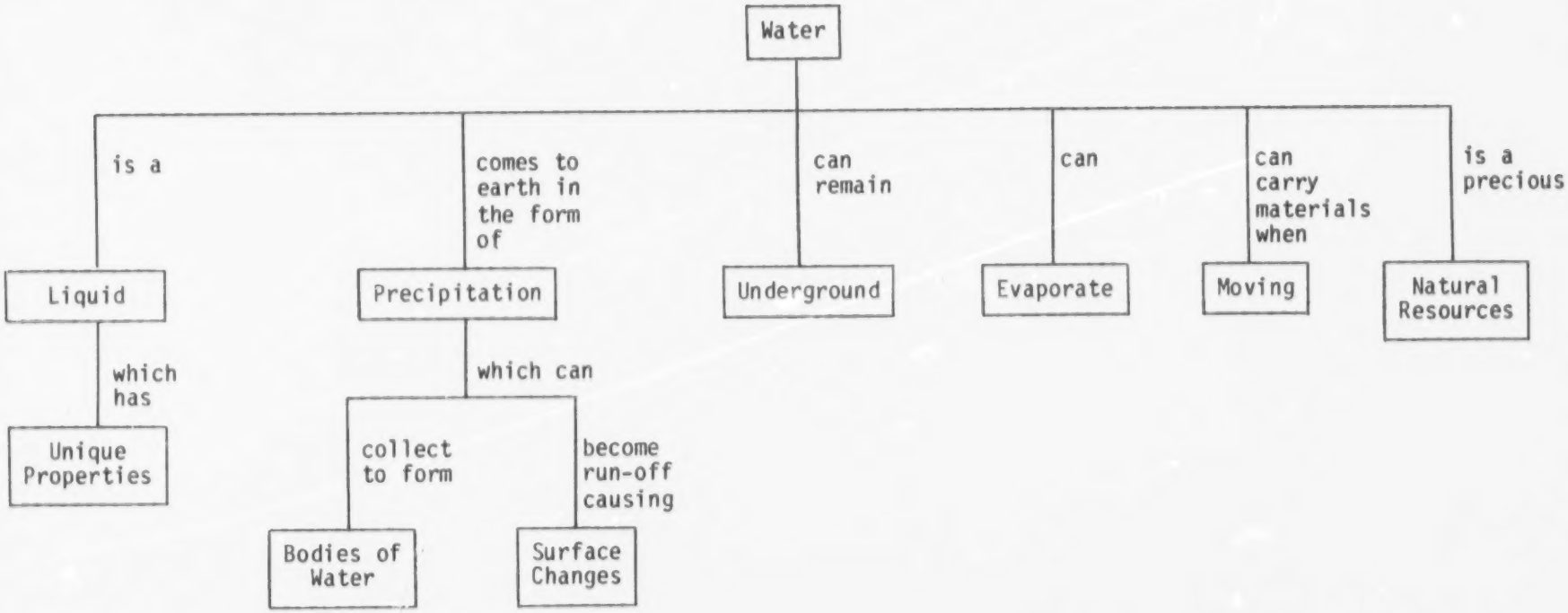
CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
9. Material from which a structure is made will affect its strength.	a) Define strength as the ability to withstand force.	
	b) Construct various structures out of various materials.*	Use paper, plasticine, wooden blocks and straws to construct structures.
	c) Observe how materials affect strength.	Test the above structures for strength.
10. Structures made of the same material can vary in the amount of weight (or force) they can support by the design.	a) Construct various structures using the same materials but changing the design.*	Use three pieces of construction paper and make towers such as: Predict the strength of each. Test using hard covered textbooks. Discuss the need for fair tests re number of books, size of books, type of paper, etc.
	b) Observe and describe the variables in design which affect strength.	ENRICHMENT Make the best egg protector using designated materials. Test by dropping the protector with the egg from various heights.
11. Shape is an important property affecting structure.	a) Infer that the strength of an object is dependent upon its shape.	Compare the cylinder to bones. Use your thumb and any finger and try to break an egg.

BEST COPY AVAILABLE

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
12. Structures use different sizes, shapes, designs and materials to give the most strength.	a) Observe, measure and record the effect of additional layers on the strength of a structure.	Lay a strip of cardboard over a gap between two piles of books. Place a weight in the center on top of the strip. The weight should be large enough to bend the cardboard strip. Add additional strips on top of the first one until the weight can be supported.
	b) Design, construct, and test bridges to give the most strength.**	Having ten straws construct a bridge that is 1.5 straws in length. Determine the best design by the amount of weight it will hold. (Plasticine may also be used.) Use spaghetti and marshmallows to build a structure 100 cm high that will hold ball of clay.
	c) Observe and discuss structures around you and what gives them their strength.	Observe pictures of bridges and their designs. ENRICHMENT Build a sturdy house with as few pieces as possible. Use different materials, i.e., straws, paper, toothpicks, popsicle sticks, etc.
	d) Design ways to test hypotheses using materials.	

GRADE FOUR

EARTH, SPACE AND TIME: WATER AND LAND



GRADE FOUR

TITLE: EARTH, SPACE AND TIME: WATER AND LAND

RATIONALE: Through the use of process skills, children will recognize the importance of water and the conservation of water and land.

MAIN CONCEPT(S): Water is a liquid which erodes the land. Water supports and transports materials. Water is a valuable natural resource.

* Refers to problem solving
** Refers to STS
*** Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. Water is a liquid and has unique properties (review of Grade 2).	a) Observe the properties of water.	Note that it: - pours - drips - can be stirred - has weight - is wet - takes the shape of the container - exists in several states.
2. Rainwater falls onto the land and runs downhill to collect into lakes, rivers, and finally the sea.	a) Observe the effects of rainwater on the local environment.	Note that water always takes the easiest path; either it seeps into the earth or it runs off. If it cannot do either, it becomes trapped and collects to form ponds. Discuss the local environment in these terms and make observations as to where rain water collects, seeps in, or runs off.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	b) Observe and list ways in which society is affected by and deals with rain water.** ***	Observe eavestroughs, sewers, gutters, glass in windows, floodways, ditches, awnings, and umbrellas. After a rain, study the school yard for the effects of rain. Research ways for people to gather and use rainwater to their benefit.
3. Rainwater is one form of precipitation.	a) Construct and read a rain gauge.	Have students make simple rain gauges and chart rainfall over a period of time. Plot the data on a simple bar graph.
	b) Observe and list other forms of precipitation.	Discuss sleet, hail, fog, snow, dew.
	c) Predict and test the water equivalent of snow.	Reserve this activity for the winter session. To test it, melt a measured amount of snow to determine water content. This could be done for successive snowfalls to see if there is a difference in water content from one snowfall to another.
	d) Observe and list ways in which society is affected and deals with other forms of precipitation.** ***	Discuss how heavy snow causes less frost, traffic hazards, snow cleaning problems, insulation, roof problems.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
4. Moving water wears away the land.	a) Observe the erosive effects of flowing water and the formation of land features.	Construct a mini-mountain and direct a flow of water on it. Increase and decrease water pressure and note the effects. Set certain features on the mountain, such as trees, grass, rocks, buildings. Observe actual photos of river paths.
	b) Observe the erosion effects of freezing water.	Fill a ziplock baggie (or a hollowed out egg or a plastic bottle) with water. Place in freezer overnight and observe next day.
	c) Describe and appreciate how these forces affect the environment.** ***	Make a model to test erosion, i.e., stream table. Collect data with varying amounts of water flowing, different slants on the land, different land cover. Observe the amount of soil transported for each variable and make inferences.
	d) Be aware of the vulnerability of man upon geological forces.	Discuss the effects of droughts, floods, hurricanes, tornadoes, and monsoons.
5. Moving water makes rocks smaller and rounder.	a) Predict the effects of movement in water upon rock particles.	Take three plastic containers and place 25 limestone chips in each. Half fill #1 with water and shake 3,000 times. (Have students in groups and take turns at shaking the container). Half fill #2 with water and shake 1,000 times. Half fill #3 with water but do not shake. Compare the pebbles and water in each container.
	b) Infer the effect of movement on rock particles in rivers and streams.	
	c) Describe possible benefits of moving water on rocks.**	Collect rocks from a riverbed, if available, and observe their shapes and textures. Discuss sand and soil formation.

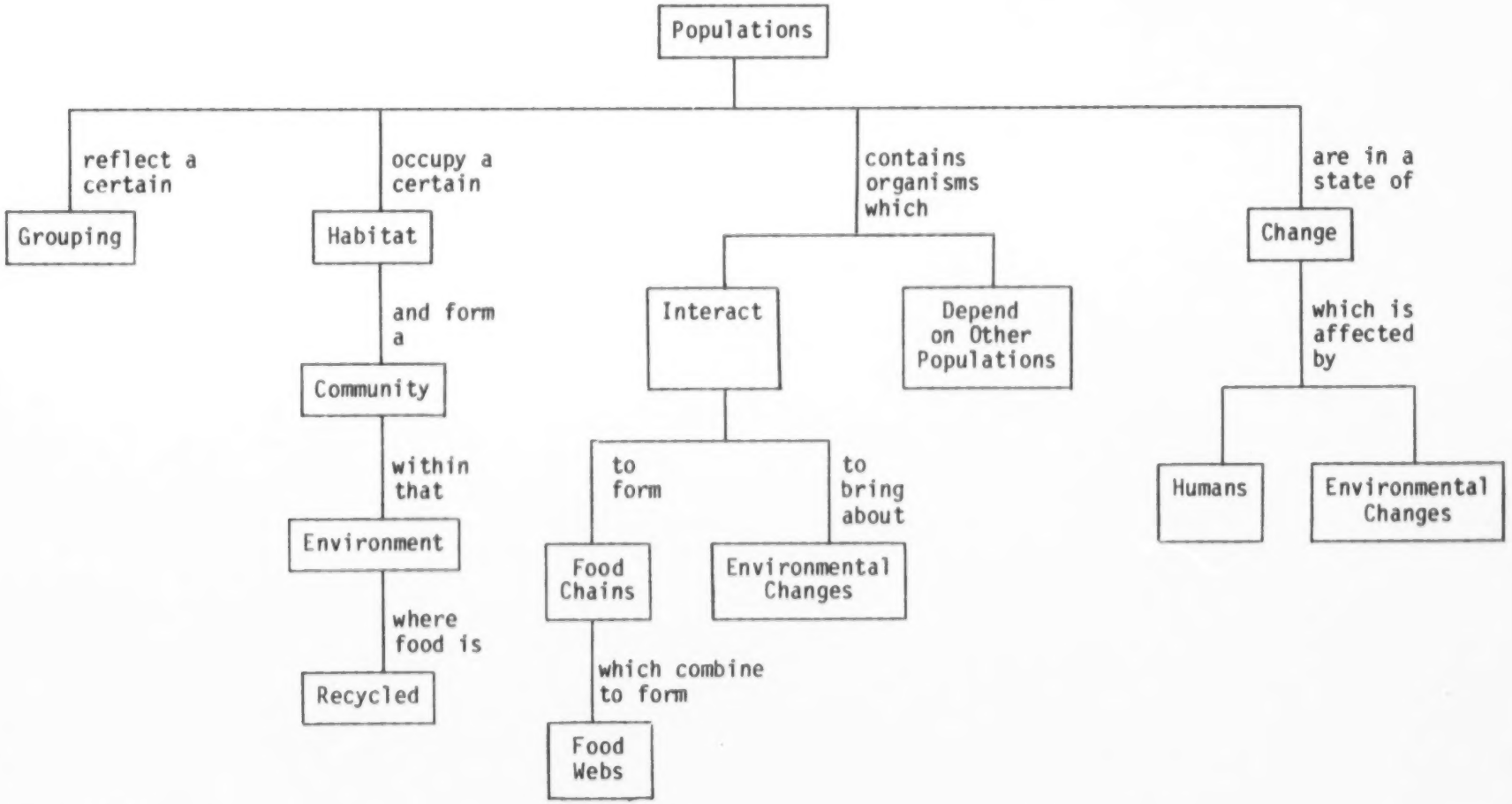
CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	d) Discuss ways in which man uses running water on rocks for his own purposes.	Discuss such things as rock polishing, brass polishing, flushing tailings from mines, gold panning.
6. Moving water can hold more material than still water.	a) Observe and test that moving water holds more material than still water.	Jars of water and equal amount of soil into two jars of water. Shake one and then observe both. Record changes over a period of time. Discuss flood plains and deltas in terms of moving water carrying material and what happens when this water slows down.
7. Some water sinks into the land and some evaporates.	a) Predict and test the effects of evaporation and absorption on water levels.*	Obtain two glasses. Fill one with soil. Add an equal amount of water to each glass. Mark the water levels in both glasses. Allow the glasses to stand, uncovered, for a number of days. Mark the water levels at the same time each day to see if any change has occurred. Discuss the results.
	b) Predict and test the ability of different soils to absorb water.	Measure a litre of water. Measure how much air is displaced by water in peat moss, soil, clay, and sand, etc. ENRICHMENT Design a test to measure the water infiltration rate of different soils.
8. The ground holds water in the spaces between pebbles and soil particles. This is called ground water. The level of water below the surface is called the water table.	a) Observe that there are spaces between particles which could hold water. b) Predict and record the amount of air displaced.*	Fill a jar with pebbles. Cover with your hand and invert jar in a tub of water. Allow pebbles to fall out, keeping the jar opening below water. Note amount of water that fills jar. Account for the air space at the top of the jar. Test using different soil mixtures.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
9. Water evaporates and condenses to form clouds. The clouds release this water which falls in some form to the earth again (water cycle).	a) Observe and describe the changes in water as it goes through its cycle.	Demonstrate rain. Heat a tin of water to boiling on a hot plate. Note the cloud. Hold a pan of ice over the cloud and note the results. ENRICHMENT Construct and observe a terrarium.
10. Water is a precious natural resource.	a) List and describe ways in which we depend on water.** b) Collect and record information on how we are using this resource beneficially.** ***	The list should include: drinking, washing, bathing, irrigation, hydroelectricity, transportation, recreation, and industry. ENRICHMENT Research hydro power. ENRICHMENT Estimate, measure and record the amount of water used at school/at home in one day/week/year.
11. Humans have serious water problems.	a) Observe and list the water problems related to water.** b) Describe ways of managing water.** ***	Discuss the lack of water, the over-abundance of water, and the pollution of water. Discuss such things as floodways, irrigation, water purification plants, aeriation of water, and planting of vegetation on slopes and along river banks.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
12. Clean water is an essential resource for the environment.	a) Describe how water affects the whole environment.** ***	Discuss the formation of acid rain. Water two similar plants regularly over a period of time. Add vinegar to the water which is given to one of the plants. Make observations over the time period.
	b) List ways that humans are polluting the water.***	ENRICHMENT Water treatment plant. Using straws, a tin can, small rocks, sand, two loaf pans, lime, alum and mud.
	c) Infer the effect of serious water shortages.** ***	Discuss water sales (internationally), flooding for hydro plants, fishing, and rationing of water.
	d) Describe possible ways of dealing with these problems.*	

GRADE FOUR

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: POPULATION INTERACTIONS



120

121

GRADE FOUR

TITLE: INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: POPULATION INTERACTIONS

RATIONALE: Through the use of basic processes, children will recognize that living organisms and the environment influence each others; and humankind may cause environmental changes.

MAIN CONCEPT(S): Living organisms interact with each other and other populations. Populations and environments influence each other.

*Refers to problem-solving
**Refers to STS
***Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. Population describes a group of organisms of the same kind in a particular environment.	a) Define a population.	Note that populations vary, grow and develop in different environments. Interaction occurs within and amongst populations. List different populations in your community. ENRICHMENT Test an area for dandelion population. EYE: The Dandelion.
	b) Observe and identify populations in various environments and classify as plant or animal.	Go for a walk and identify various populations in a park, on a street, etc.
2. Populations in a particular habitat form a community.	a) Define habitat.	Discuss "habitat" and agree upon a definition.
	b) Observe a community and identify its various populations.	Class, park forest, beach, etc.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
		Make a manual of an ecosystem. Research different animals and place them on the mural in the appropriate habitats. Connect the animals to all components in the ecosystem that it interacts with (i.e., what it eats, is eaten by, needs for habitat), using a different coloured string for each animal.
	c) Identify the relationships between populations in a community.	Discuss various situations which could happen in a community to interfere with the interdependence of populations i.e., fewer berries--fewer birds; fewer cattails--fewer muskrats, fewer mice--fewer owls.
	d) Predict how the removal of one population in a community affects the rest of the community.**	Discuss what would happen if mosquitoes, mice, or rabbits left a community. Discuss what would happen if predators left a community.
	e) Infer causes of population decrease.** ***	Discuss use of pesticides, herbicides, unrestricted hunting, starvation, destruction of natural habitats.
	f) Recognize possible problems for human populations.** ***	Discuss earthquakes, floods, fires, famine, over population, drought.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
3. Organisms interact within a population. Many are dependent on others.	a) Observe, describe and chart interactions necessary for animals to build their homes.	Research the needs of robins, muskrats, bees, bears, or humans and report on how these needs are met.
	b) Infer ways in which various animals care for their young.	
4. Populations of animals depend on other populations for food.	Classify organisms as herbivores, carnivores, or omnivores.	Design a test to determine whether an animal is a herbivore, carnivore, or omnivore. If possible, test this using a classroom pet.
a) Plant eaters (herbivores).	a) Define plant eaters.	
b) Meat eaters (carnivores).	b) Infer that some organisms are carnivores.	
c) Both plant and meat eaters (omnivores).	c) Infer that some organisms are omnivores. Identify above three classifications.	Give students a list of animals and have them place them under the correct headings.
5. Animals may interact in a predator-prey relationship.	a) Observe and classify predator-prey relationships.	ENRICHMENT Predator/prey frozen tag. Select prey and appropriate predators. Each prey animal needs three food tokens to say alive. Place food tokens (cardboard circles) at one end of playing field. Prey animals at one end of playing field. Prey animals move from permanent shelter to collect one food token at a time, then return. They may "freeze" or find cover to save themselves. Predators may

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
		only catch moving prey. Captured prey and their successful predators move to the side lines. Keep each round down to five minutes.
		Use hula hoops for cover areas.

FOOD TOKENS
cover cover cover cover cover
PERMANENT SHELTER

	b) Infer that colour is important for an animals' survival.	Graph the number of objects found in a specific area in a given amount of time based on color such as green toothpicks in the grass compared to white toothpicks.
	c) Predict the results of changing an animal's colour.	Cut animals out of a picture and replace them with a different coloured image. Discuss the chances of the animal's survival. Discuss the effects of having a black-haired polar bear; a red garter snake, etc.
6. Food is recycled within an environment.	a) Review the requirements for growth of green plants.	
	b) Classify plants and animals according to producer, consumer, decomposer.	

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	c) Discuss "scavenger".	
	d) Observe and record changes in decomposing matter. Interpret the data.**	Discuss landfill sites and compost holes. Start a bread mold colony. Keep fruit in a sealed jar. Observe daily and record visible changes. Visit a mushroom factory, if possible. Study the effects of lichen growth on the environment.
7. Organisms interact with each other in a food chain.	a) Identify and record organisms which make up a food chain.***	Have students build food chains from a picture file or begin with a caterpillar and draw an appropriate food chain.
	b) Observe the effect of removing a member from a food chain.	
8. Food chains form more complex food webs.	a) Communicate food webs by means of diagrams.	Play a food web game, using a ball of wool to represent the web and having each student representing a member of the web.
9. Populations are in a state of change. They are affected by environmental factors.	a) Observe that populations react to environmental stimuli.	List habitat factors which cause change, i.e., sunlight, air, water, food, space, soil, pollution. Grow bird seed under various situations.
	b) Infer causes of population decrease/increase.** ***	Discuss such things as health measures, nutrition, crowding, pollution, disease, and wars.
10. Populations interact to cause environmental changes.	a) Observe how one kind of animal can cause environmental changes.** ***	Discuss pros and cons of beavers, termites, bats, spruce budworm, Dutch elm disease, tent caterpillars, earthworms, and dragonflies.
	b) Infer the interactions of one kind of organism with its environment.	

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
11. Humans interact with other organisms to become part of a network of populations, and need to do so responsibly.	a) Infer how humans interact with other organisms.** ***	Discuss and list types of wildland conservation. Visit Oak Hammock marsh or other wildlife management areas.
	b) Recognize human ability to endanger a population or to cause it to become extinct.** ***	Discuss habitat destruction. List endangered and extinct plants and animals. Research how some populations became endangered/extinct.
	c) Recognize human ability to endanger its own population.**	
	d) Develop respect for the natural order and beauty of the environment.***	

RESPONSE QUESTIONNAIRE FOR K-9 SCIENCE PROGRAM OF STUDIES

Please return this questionnaire by January 15, 1992 to the:

Science Consultant
Curriculum Services
Manitoba Education and Training
411-1181 Portage Avenue
Winnipeg, Manitoba R3G 0T3

Please respond to each question in the space provided. (Attach extra sheets if more space is required). Use the page references when making specific comments.

1. Does the guide provide you with sufficient information as to nature and scope of the science program?

_____

_____

2. Are you able to adequately cover the stated objectives within the available class time?

_____

_____

3. Are your students capable of achieving the objectives listed in the unit(s)?

_____

_____

4. Is there sufficient variety in the activities to allow all students to take part in the program?

_____

5. Which activities are too simple or too difficult for the intended grade level?

_____

_____

6. Which activities do not seem to work well?

_____

_____

...../2

7. Which activities require clearer directions?

8. Are there sufficient material resources in your school to enable you to adequately teach the program?

9. Is there difficulty in obtaining science materials in order to carry out the activities?

10. Do the students enjoy or appreciate the program?

11. What are some specific features of the program with which you are pleased?

12. Within the framework of the revised program, please make suggestions which, in your opinion, may result in significant improvements.

NAME: _____ SCHOOL: _____

GRADE: _____ PHONE: _____

THANK YOU FOR YOUR ASSISTANCE.